Final Report for Period: 09/2007 - 08/2008
Submitted on: 11/22/2008
Principal Investigator: Lacey, Michael T.
Award ID: 0648811
Organization: GA Tech Res Corp - GIT
Submitted By:

Title:
Special Meeting: Fields Program on New Trends in Harmonic Analysis - International U.S. Participation

Project Participants

Senior Personnel

Name: Lacey, Michael
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Keyfitz, Barbara
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

This program had principle organizers Izabella Laba (Vancouver), Michael Lacey (Georgia Tech), and Alex Iosevich (Missouri). Many of the funding and scheduling decisions were made by the organizers of the three different workshops, which included the organizers, Kristian Seip (Norway), Malabika Pramanik (Vancouver), David Ellwood (Clay Math), Andrew Granville (Montreal), Bryna Kra (Northwestern), Izabella Laba (UBC), and Trevor Wooley (Bristol).

Activities and Findings

Research and Education Activities:

This is a final report on grant DMS0648811, made to support US based researcher's participation in the Thematic Program in Harmonic

Analysis at the Fields Institute, January-June 2008.

This program had a full complement of research and training components, including graduate courses, regular seminars, and international conferences. A full range of participants from Canada,Europe and the US and the rest of the world participated in the Program, with graduate students and postdocs in residence for the entire program.

Description of Participant Selection

Selection of participants was guided by criteria by the fundamental principles of using the funds to support the current and future health of the discipline. Some resources were spent to ensure high-level presentations at the workshops, which would set the right intellectual tone and level for the science disseminated at the conferences and the workshop. A second set of resources were devoted to current researchers who were not supported by the NSF, seeking to insure a breadth of support across US based participants. A third set of support was provided to researchers at an early stage of research, including postdocs and graduate students. Indeed, by numbers, half of the participants supported by this grant were early-stage researchers.

Findings: (See PDF version submitted by PI at the end of the report)

Persons Supported

The attached report contains a tabulation of people supported by this grant listed by name, affiliation and sum awarded. We have also noted some additional information as to breadth of support, by noting GS=Graduate Student, PD=Postdoc, W=Woman, and M=Minority, where appropriate. There were

* 54 people supported by the grant.
* 18 of these, or 33%, were graduate students.
* 10, or 19%, of these were Postdocs.
* 8, or 15% of these were minority or women.

Among the minority or women, Alberto Condori, Lillian Pierce, Constance Liaw and Maria Reguera-Rodriguez are all very promising graduate students-at four different universities. Reguera-Rodriguez was a long-term participant in the program, and gained a great deal from the participation. [These figures only represent the funds charged to this grant. Another 52 US based participants were supported from other funds, and so the figures above are not completely representative of the US participation in this program.]

Tabulated participant statistics along with information on the meeting and highlights of the program are included in the attached pdf file.

Training and Development:

Outreach Activities:

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):

www.fields.utoronto.ca/programs/scientific/07-08/harmonic_analysis/

Description:

This site was used to maintain conference data as it became available keeping participants completely up-to-date on the conference's progress.

Other Specific Products

Contributions

Categories for which nothing is reported:

Organizational Partners

Activities and Findings: Any Training and Development

Activities and Findings: Any Outreach Activities

Any Journal

Any Book

Any Product

Any Contribution

FINAL REPORT ON NSF GRANT DMS0648811 FIELDS INSTITUTE, THEMATIC PROGRAM ON HARMONIC ANALYSIS

1. Persons Supported

Participant		Institutional Address	Sum Awarded
Bateman, Michael	GS	Indiana U	998.60
Bergelson, Vitaly		Ohio State U	1083.82
Cima, Joseph		U of North Carolina	872.51
Condori, Alberto	GS,M	Michigan State U	755.17
Demeter, Ciprian	PD	Institute for Advanced Study	487.91
Erdogan, Burak		U of Illinois, Urbana-Champaign	603.22
Gautam, Sushrut	GS	U California, Los Angeles	472.18
Goldberg, Michael		Johns Hopkins U	397.77
Grafakos, Loukas		U of Missouri-Columbia	477.05
Greenleaf, Allan		U of Rochester	898.11
Gressman, Philip	PD	Yale U	1110.21
Hart, Derrick	GS	U of Missouri-Columbia	242.81
Hjelle, Geir Arne	GS	Washington U	622.30
Hofmann, Steve		U of Missouri-Columbia	776.38
Ionescu, Alexandru		U of Missouri-Columbia	365.42
Iosevich, Alex		U of Missouri-Columbia	2082.71
Jury, Michael		U of Florida	844.48
Knese, Gregory	PD	U of California, Irvine	1233.12
Koh, Doowon	GS	U of Missouri-Columbia	242.81
Kucherenko, Tamara	PD,W	U California, Los Angeles	854.04
Kwon, Hyun-Kyoung	GS,W	Brown U	775.87
Li, Xiaochun		U of Illinois, Urbana-Champaign	549.72
Liaw, Constanze	GS,W	Brown U	750.15
Lin, Yonhow	GS	Washington U	756.40
Lyall, Neil		U of Georgia	1875.22
Maz'ya, Vladimir		Ohio State U	778.72
Mei, Tao	PD	U of Illinois, Urbana-Champaign	872.87
Mitkovski, Mishko	GS	Texas A&M U	765.08
Muscalu, Camil		Cornell U	596.28
Nagel, Alexander		U of Wisconsin-Madison	839.60
Okoudjou, Kasso	M	U of Maryland	784.32
Olsen, Jan-Fredrik	GS	Washington U	774.61
Perez, Carlos		Univ of Kansas	199.72

Pierce, Lillian	GS,W	Princeton U	485.64
Reguera-Rodriguez,	GS,W	U of Missouri-Columbia	2522.62
Rochberg, Richard		Washington U	779.05
Schul, Raanan	PD	U California, Los Angeles	499.30
Sedlock, Nicholas	GS	Washington U	756.40
Seeger, Andreas		U of Wisconsin-Madison	759.56
Slavin, Leonid	PD	U of Missouri-Columbia	8452.67
Smith, Hart		U of Washington	819.03
Smith, Matthew	PD	U of Georgia	499.30
Sundhall, Marcus	GS	Washington U	622.30
Tecu, Nicolae	GS	Yale U	696.18
Torres, Rodolfo		U of Kansas	199.72
Treil, Sergei		Brown U	782.12
Trent, Tavan		U of Alabama	842.38
Uriarte-Tuero, Ignacio	PD	U of Missouri-Columbia	591.95
Valdimarsson, Stefan	PD	U California, Los Angeles	492.56
Volberg, Sasha		Michigan State U	1560.19
Xiao, Xiao	GS,W	Brown U	767.68
Xu, Xiangjin		Binghamton U	493.36
Yung, Po Lam	GS	Princeton U	487.91
Zheng, Dechao		Vanderbilt U	863.64
			$49712.74

2. Information on Meeting

Graduate Courses: Graduate courses were Number Theory, lead by John Friedlander, and Operator Theory, lead by Eric Sawyer. Both were attended by graduate students and postdocs associated with the Program. While teaching the course, Eric Sawyer wrote a 300 page manuscript, which is now being considered for publication by the AMS.

International Congresses/Workshops The three international congresses were on the themes of (1) Operator Theory, (2) Harmonic Analysis and (3) Arithmetic Combinatorics, with approximately 100 lectures over all.

(1) **Operator Theory:** The opening workshop, January 7-11 2008. Approximately 20 lectures, with lecturers including speakers from several countries in Europe, Israel, and the US.
(2) **Harmonic Analysis:** Midway through the program, with 39 speakers, from Canada, the US and Europe.
(3) **Arithmetic Combinatorics, Harmonic Analysis, and Number Theory:** April 5-13, 2008. This conference featured talks by three Fields medalists, Terrance Tao, Jean Bourgain and Timothy Gowers. As one would expect, the secondary speakers were also at a

very high level: Szemeredi, Ben Green, Akshay Venkatesh, Alex Samorodnitsky, Bryna Kra, ... There were over 40 lectures, over nine days.

In total, there were 192 registered participants, 21 countries represented in all activities of the program. Note that the US participants totaled 106, of which about one-half were supported by this grant.

Countries	**Number of Participants**
Argentina	1
Australia	2
Austria	1
Canada	35
China	2
Czech Republic	1
Finland	2
France	4
Germany	2
Greece	1
Hungary	2
Israel	6
Italy	2
Japan	2
Norway	1
Russia	2
Spain	4
Sweden	1
Tunisia	1
United Kingdom	11
United States	106

Three participants did not list an affiliation.

3. Highlights of the Program

The attendees of the courses spoke highly of the quality of the presentation and level of the courses. One of the courses has produced a book.

The three conferences were all successful, still the Arithmetic Combinatorics conference was both at a very high level, very broad and intellectually a very stimulating event.

The Fields Institute sponsored two Distinguished Lecture Series, one by Jill C Pipher (Brown), just before the second conference, and Timothy Gowers, during the last conference. Both were highlights of the program.

Dmitriy Bilyk (IAS) comments: "The semester spent at the Fields Institute provided me with a unique research environment: variety of harmonic analysts, both young and established, gathered at one place, made collaborations, exchange of ideas and fruitful discussions a part of daily routine. This program was definitely very productive for me in terms of both research and establishing new scientific ties."

Ignacio Uriarte-Tuero comments: "During my visit at the Fields Institute I collaborated with Michael Lacey and Eric Sawyer and we proved what so far are the best two theorems in my whole life (Astala's conjecture, a 14-year old conjecture by Astala, who got the Salem prize for a paper in which he states that conjecture; a characterization of two weighted norm inequalities for maximal singular integrals.) Also I had very nice mathematical conversations and learning experiences from the people around."

Maria Reguera-Rodriguez comments "I loved it and I am really grateful for the opportunity I was given. No one can imagine how glad I am to have participated in such a great program. I enjoyed Eric Sawyer's graduate class from the first day to the last one, I also enjoyed John Friedlander's, but personally I like operator theory more. I have enjoyed every talk in the seminars and the conferences, because they have opened my eyes to the main problems that the mathematical community is interested in and also to useful ideas to approach those, I remember specially Tim Gowers lecture series. I think I have extremely benefited from my conversations with Alex Iosevich, Ignacio Uriarte, Eric Sawyer, Tuomas Hytonen, Nir Lev, Brett Wick and Michael Lacey."

In terms of intellectual accomplishments, we point to these individual projects of note, which point to a bright future for two US based postdocs involved, namely Wick (South Carolina) and Uriarte-Tuero (MSU).

- Brett Wick, a US based postdoc, now at South Carolina, initiated two significant projects with Eric Sawyer (McMaster), and coauthors. The first characterizes bounded Hankel forms on the space of analytic functions known as Dirichlet space. This characterization had been open for more than 10 years.
- Wick and Sawyer, with Costea (McMaster), a postdoc in the Fields program, have also produced novel Corona Theorems on Drury-Arveson space. Corona Theorems concern the algebraic structure of spaces of bounded analytic functions, with the famous Theorem of Carleson concerned with bounded analytic functions on the disk. The results of Costea, Sawyer and Wick are the first Theorems of this type for bounded analytic function spaces of the unit ball in several dimensions, including the Drury-Arveson space (but unfortunately, not H^∞ of the ball). [arXiv:0811.0627 Title:

The Corona Theorem for the Drury-Arveson Hardy space and other holomorphic Besov-Sobolev spaces on the unit ball in $\mathbb{C}^n$.]

- Ignacio Uriarte-Tuero, a US based postdoc now at Michigan State, with Michael Lacey (Georgia Tech) and Eric Sawyer (McMaster) solved a long-standing conjecture of Kari Astala on distortion of Hausdorff measure by quasi-conformal maps in the plane. Key to this is a certain weighted estimate for the Buerling transform. [arXiv:0805.4711 Astala's Conjecture on Distortion of Hausdorff Measures under Quasiconformal Maps in the Plane. Submitted to Acta Math.]
- Lacey, Sawyer and Uriarte-Tuero have also proved the first characterizations of two-weight inequality for maximal truncations of singular integrals. Two-weight inequalities for the Hilbert transform remain one of the most interesting and challenging questions in real-variable Harmonic Analysis. And the result below contains celebrated results of Tolsa, and Nazarov-Treil-Volberg on the boundedness of the Cauchy integral on certain measures in the plane. [arXiv:0807.0246 A characterization of two weight norm inequalities for maximal singular integrals M. T. Lacey, E.T. Sawyer, I. Uriarte-Tuero. Submitted to JAMS.]